Enhanced sensitivity and response bias for male anger in women with borderline personality disorder

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Abstract

Interpersonal difficulties, which are a central feature of borderline personality disorder, may be related to problems with social cognition. We explored facial emotion recognition in 44 women (15 with BPD, 15 healthy controls, and 14 with a history of childhood trauma but no BPD) examining the role that BPD and abuse history played in the ability to detect fearful, angry and happy cues in emotional faces. In Task 1, participants viewed pictures of morphed faces containing different percentages of specific emotions and reported the emotion they saw. In Task 2, participants were asked to increase the intensity of a specific emotion on an initially neutral face until they could detect that emotion in the face. Recognition of fear was not associated with abuse history or BPD. Recognizing happiness was also unrelated to BPD, although a history of childhood abuse predicted problems recognizing happiness, particularly in female faces. Across both tasks, the more women reported symptoms of BPD, the earlier they detected anger expressed in male faces. BPD symptoms also predicted the misidentification of anger in male (but not female) faces that contained no anger cues. Findings suggest that participants with BPD have an emotional processing bias toward seeing anger in males and that this is independent of abuse history.

Keywords: borderline personality disorder, childhood trauma, facial affect recognition, emotional sensitivity, social cognition, anger bias, rejection sensitivity

1. Introduction

Borderline personality disorder (BPD) is a severe form of psychopathology characterized by emotion dysregulation and problems with interpersonal functioning, as well as by chronic feelings of emptiness, impulsivity, and recurrent suicidal behavior. Although the etiological pathway of BPD is not well understood, negative experiences with caretakers are implicated in many theoretical models of the disorder (e.g., Bateman and Fonagy, 2003; Clarkin et al., 2007; Linehan, 1993). Adverse experiences in childhood may help explain why, compared to healthy controls, people with BPD have problems with attachment, are fearful of abandonment, and are less trusting of others (Hooley and Wilson Murphy, 2012; King-Casas et al., 2008; Levy, 2005; Unoka et al., 2009).

Models of social cognition suggest that prior expectations about other people and about relationships influence the perception of interpersonal situations (Gilbert and Malone, 1995). In the case of BPD the interaction of biological vulnerabilities and problems in early attachment relationships are thought to lead to the development of disturbances in the mental representations of the self and others (Clarkin et al., 2007; Fonagy and Luyten, 2009). Difficult early relationships may lead to biases in social cognition in people with BPD. They may also compromise the accurate detection of important interpersonal cues.

The ability to correctly read cues about the emotional states of other people is an important skill. It is also essential for appropriate social functioning. If BPD is characterized by abandonment concerns, mistrust, and sensitivity to rejection (see Gunderson, 2007), we might expect that, relative to controls, people with this disorder might be especially quick to pick up on cues that signal negative emotional states in

others. We might also expect that they might have some difficulties perceiving positive social cues. Impaired ability to detect or recognize the emotions of others could lead to failures to respond empathically. It could also result in severe relationship-damaging behaviors such as inappropriate anger or aggression, both of which are part of the clinical profile of BPD.

To date, studies of facial emotion recognition in BPD have yielded rather inconsistent findings (see Domes et al., 2009 for a review). In an early investigation, Levine and colleagues (1997) examined how well men and women with BPD were able to identify discrete emotional states. Participants viewed photographs of male and female targets displaying anger, disgust, fear, happiness, sadness, surprise, and neutral. Relative to healthy controls, participants with BPD had difficulty identifying expressions of fear, anger, and disgust.

Efforts to replicate this initial finding have yielded mixed results, however. Although some investigators report that people with BPD generally perform more poorly than controls on tests of emotion recognition (Bland et al., 2004; Unoka et al., 2011) in other studies no differences in ability to recognize emotions in static photographs of emotional faces have been found (Dyck et al., 2009; Minzenberg et al., 2006; Wagner and Linehan, 1999). Indeed, rather than reporting impaired emotion recognition associated with BPD, Wagner and Linehan (1999) found that women with BPD (all of whom had experienced child sexual abuse) were more accurate in their recognition of fear than both healthy female controls and women who had experienced childhood sexual abuse (but who did not have BPD). Women with BPD also showed a tendency to report

seeing fear in slides that did not contain fear, suggesting a bias toward fear recognition, even in the absence of fear cues.

Of course, in the real world, emotional expressions are dynamic rather than static. Adopting a more naturalistic approach, Lynch and colleagues (2006) used morphed facial expressions that ranged from neutral to maximum intensity and found that participants with BPD (the majority of whom were female) correctly identified facial affect at an earlier stage than did healthy controls. However, using a similar paradigm, and using groups matched for IQ, Domes and colleagues (2008) found no evidence of differential sensitivity to specific emotions in women with BPD compared to healthy controls. More recently, Jovev et al. (2011) have also reported no differences in emotion sensitivity in young people with BPD features and healthy controls.

The inconsistent findings of past studies may result from a variety of methodological factors. Differences in the type of stimuli used (static images versus morphed faces) and in the amount of time participants were given to make their responses may be important. The gender composition of the sample is also relevant. Some studies involved only women whereas others included both men and women. This is an issue because females tend to perform better than males on tests of affect recognition (McClure, 2000). In addition, most studies to date have not matched the BPD and control groups for cognitive ability using a measure of IQ (but see Domes et al., 2008).

Yet another potential confound is the influence of trauma history. Many individuals with BPD report a history of severe trauma (physical or sexual abuse) in childhood (e.g., Zanarini et al., 1997) and early maltreatment has been linked to the later development of BPD in prospective longitudinal studies (Johnson et al., 1999; Widom et

al., 2007). Research examining emotion recognition in children who have experienced physical abuse or neglect suggests that early trauma exposure may disrupt neural pathways that facilitate emotion processing (Pollak et al., 2000). As a result, it is important to consider a history of childhood trauma when investigating emotion perception in BPD.

Despite the inconsistencies, evidence is growing that BPD may be associated with a response bias toward detecting negative emotions. In some secondary analyses, Domes and colleagues (2008) noted that patients with BPD over-reported anger when evaluating faces that contained ambiguous blends of anger and sadness or anger and happiness. They also reported that BPD participants showed a significant reduction in their emotion detection thresholds as the experiment progressed. This enhanced learning was not present in the controls. Using the Reading the Mind in the Eyes test (Baron-Cohen et al., 2001) Scott and colleagues (2011) have demonstrated that college students with more BPD traits were better than those with fewer BPD traits at detecting negative emotions. In contrast, there was no association between BPD traits and accuracy at detecting neutral or positive emotions. Moreover, across all trials, participants with more BPD traits showed a bias toward attributing negative emotions to non-negative social stimuli. This is consistent with findings of Dyck and colleagues (2009), who asked healthy controls and patients with BPD to make a rapid decision about whether a target face was angry, fearful or neutral. Under time pressure, patients with BPD were significantly worse than controls at identifying neutral faces, misinterpreting them instead as negative. However, when asked to complete a simple test of emotional recognition without any time limit they

performed as well as controls in their ability to recognize happiness, fear, sadness, anger or no emotion in static facial expressions.

In the current study we used two dynamic facial affect recognition tasks to further explore emotional sensitivity in women with BPD. More specifically, we sought to examine the contribution of childhood trauma to emotion identification and recognition thresholds. Our use of a comparison group of people with no BPD traits but with a history of abuse allows us to examine the independent contributions that BPD traits and childhood maltreatment might make to performance on emotion recognition tasks. Finally, we examined how responses to emotional information might be influenced by the gender of the target face. This is a factor that has not been a focus of attention in previous research. However, male faces showing different emotions may be perceived differently than female faces showing those same emotions. This might be especially true for people who have BPD or a history of trauma.

In light of the association between BPD and early childhood adversity, and the link between BPD and sensitivity to rejection (Gunderson, 2007; Staebler et al., 2010) we expected that the presence of more BPD traits would be associated with more aberrant processing of emotional cues presented in the faces of others. Our first hypothesis, based on previous research (Domes et al., 2008; Scott et al., 2011), was that people with BPD would demonstrate increased sensitivity to the presence of anger in others. Anger is a cue that signals a potential threat to a relationship. It may therefore be especially important for people with BPD because BPD is characterized by abandonment concerns. We also predicted that having a past history of physical abuse would be associated with increased sensitivity to anger. This second hypothesis was based on previous research showing that

abused children are able to detect anger at an earlier stage of its formation that than non-abused children are (Pollack et al., 2009). In other words, we predicted that both BPD and abuse history would make separate and independent contributions to anger sensitivity. We did not predict a bias toward fear in our sample because recent research suggests no differences between people with BPD and healthy controls in fear appraisal (Fertuck et al., 2013). Finally, based on earlier findings showing that people with BPD demonstrate a negative bias when evaluating benign social cues (see Dyck et al., 2009; Meyer et al., 2004; Scott et al., 2011) and perceive others more negatively (Arntz and Veen, 2001) our third hypothesis was that BPD would be associated with a bias toward detecting negative emotions in faces, even when no negative emotion was actually present. We did not make any formal predictions about how the gender of the target face might moderate these relationships. Nonetheless, we thought it likely that any emotion perception differences might be most marked when participants evaluated faces of the opposite sex.

2. Method

2.1 Participants

Forty-four women were recruited via Internet postings and flyers. An exclusively female sample was recruited to minimize heterogeneity in the data. Advertisements for the BPD group requested "moody" people with "stormy relationships" (see Korfine and Hooley, 2000; 2009). Advertisements for the Trauma group requested participants who experienced "abuse" in their childhood. Advertisements for the Control participants described a study about "emotions" for people who were generally "healthy" and experienced a "happy, loving childhood". All participants received a diagnostic

screening interview. This was conducted by telephone by an experienced masters-level psychologist who had received extensive formal training and who had demonstrated high reliability against "gold standard" SCID training tapes. All participants provided written informed consent to a research protocol approved by the local Committee on the Use of Human Subjects.

Participants were between the ages of 18 and 55 and all had at least a high school education. Sixty participants completed a telephone screening interview. Fifteen participants met DSM-IV criteria for BPD as determined by a telephone screening interview and later confirmed via an in-person diagnostic assessment. A further 15 Control participants were free of current Axis I and Axis II pathology. Control participants were excluded if they reported more than one BPD symptom or reported any incidents of childhood trauma. Finally, 14 participants reported more than one physically or sexually abusive experience in their home before the age of 10. Trauma participants were included whether or not they met diagnostic criteria for any disorder, except for BPD.

2.2 Procedures

Participants completed a phone screen that included the BPD section of the SCID-II. Those meeting entry criteria were then invited to visit the research laboratory for one three-hour session that included diagnostic interviews and administration of the computer-based experimental tasks. Participants were assessed for the presence of Axis I disorders using the Structured Clinical Interview for DSM-IV (SCID-I) (First et al., 1996a). Axis II disorders were assessed using the Structured Clinical Interview for DSM-IV Axis-II Personality Disorders (SCID-II) (First et al., 1996b). All participants

completed an interview about their abusive experiences, self-report questionnaires, and two emotion identification/recognition tasks. Measures and emotion identification tasks are described below.

2.3 Clinical measures

2.3.1 Childhood Maltreatment Interview Schedule (CMIS).

Childhood trauma was assessed using the CMIS (Briere, 1992). This is an 11-item interview that asks about exposure to various types of trauma in childhood. Questions concern violence between parents as well as physical, sexual, and emotional abuse inflicted upon the participant. Because responses to the interview questions are not summed to form scales, there are few formal psychometric data on this instrument. However, research suggests that it has good concurrent and predictive validity (Briere and Runtz, 1988; 1990; Swahn et al., 2006). This measure was also used to assess abuse in the study of Wagner and Linehan (1999).

2.3.2 Shipley Institute of Living Scale

The Shipley Institute of Living Scale (Shipley, 1967; Zachary, 1991) provides a brief and valid assessment of general intellectual functioning (see Matthews et al., 2011). To reduce time burden on participants we administered only the verbal section. This requires participants to indicate the correct definitions for 40 vocabulary words using a multiple choice format.

2.4 Experimental Tasks

We used two tasks to assess identification and recognition of emotional and non-emotional facial cues. Both tasks were designed and conducted using Psyscope (Cohen, et al., 1993) and run on a Macintosh laptop computer. Experimental stimuli were taken

from standard emotional face slides constructed by Ekman and Friesen (1976). To limit the duration of our laboratory session and reduce the potential for fatigue in our participants, we focused on three of the six universally identifiable emotions -- happiness, anger, and fear. These were selected because of their relevance to BPD and trauma.

2.4.1 Task 1: Emotion Identification The first task assessed participants' ability to identify discrete emotional states when the emotion was depicted at different levels of intensity. Two faces (one male and one female) were selected from the Ekman and Friesen (1976) series based upon the consistency of high ratings of recognition according to published norms for happiness, anger, and fear. Using a computer program, each face was morphed with the neutral face photograph of the same individual and expressions of emotional intensity were then varied in ten percent increments. Participants viewed 11 photographs for each emotion for each face (male and female) (e.g., neutral, 10%, 20%, 30%, 40%, 50%, 60%, 70%, 80%, 90%, 100% happy). The 100% face was the prototypical face for each specified emotion. For each emotion (happy, fear, anger) a total of 22 related images were presented (11 for each gender face). Participants viewed a total of 62 images (3 emotions, 9 different morphs for each, 1 prototypical for each emotion, 1 neutral, multiplied by 2 for male and female model).

Participants were given a four minute practice period to acclimate to the procedure. The practice period was identical to the experimental phase except for the models in the photographs. After each participant completed the practice period and understood the task, the experimental phase began.

Participants first viewed a screen with the following instructions.

You are about to see a series of faces. After viewing each face, please decide which emotion appeared on the face. If the face appeared Happy, press the H key. If the face appeared Angry, press the A key. If the face appeared Scared, press the S key. If the face appeared Neutral, showing no emotion, please press the N, or Space bar. When you are ready to begin, please press any key.

Four keys on the keyboard were labeled with stickers of H, A, S and N. These were pointed out by the experimenter. When the participant indicated that she was ready to begin, the experimenter left the room and the participant pressed any key on the keyboard to begin the task.

A single face appeared on the screen for 500 milliseconds. Participants responded by pressing a labeled key on the keyboard. To reduce any effects of anxiety or impulsivity participants were allowed an unlimited amount of time to decide what emotion they perceived. After each response, another image appeared on the screen. The order of image presentation varied randomly by gender of target and emotion portrayed. Each image was randomly presented 4 times for a total of 248 stimuli presentations.

2.4.2 Task 2: Emotion Recognition

The second task tested recognition threshold for specific emotions. Faces depicting happiness, anger, and fear were used and the images were identical to those used in Task 1. Participants were prompted with the following instructions for each specific condition: *You are about to see a series of faces. If the face on the screen appears happy press the red key. If it does not appear happy press the blue key. Please press the space bar to begin.*

Two keys on the keyboard were clearly marked with a red or blue sticker. Participants were prompted with instructions noting the target emotion before each series of photographs appeared. After the participant pressed the space bar, a neutral face appeared. When the participant pressed the blue key the next face in the series appeared (e.g., a 10 percent happy face). If the participant pressed the blue key again, the 20 percent happy face appeared. The faces remained on the screen until the participant made a decision as to whether or not the target emotion was present. Thus each participant viewed between one and eleven photographs in a series. When the participant decided she had seen the target emotion she pressed the red key, ending that trial. The same procedure was then followed for the other target emotions. Each block of images was presented in random order, varying gender of the target and the emotion being depicted. Each participant received the instructions to look for a happy (or angry, or fearful) face eight times (four times with a female target, four times with a male target). The total number of stimuli presented varied for each participant depending on when she identified the emotion being depicted.

We used a 500 ms stimulus presentation time in Task 1 because this interval is just long enough for participants to be able to consciously perceive the images, but not long enough to permit prolonged, effortful processing (Sprengelmeyer et al, 1997). In Task 2 we did not restrict stimulus presentation time because we were interested in how engaging in effortful processing might change emotion recognition.

2.4.3 Data Analytic Plan

For descriptive purposes we used oneway ANOVAs to compare the three groups on demographic variables. We then used Fisher's exact tests to explore differences

between the trauma and BPD groups with regard to clinical diagnoses and type of trauma exposure. Based on previous research, we expected that any emotion recognition differences associated with abuse history and BPD might be both subtle and limited to specific emotions. Accordingly, we collapsed across groups and used a series of hierarchical linear regression analyses to examine the contributions of abuse history and BPD symptoms to emotion recognition thresholds in Task 1 and Task 2. Two abuse history variables (presence or absence of physical abuse and sexual abuse) were considered because we thought that both of these might have the potential to bias social cognition. Abuse history was entered in Step 1 followed by BPD symptoms in Step 2. We used this approach rather than ANOVA because although control participants had no history of trauma or BPD, the BPD group contained participants with and without a history of trauma and the trauma group contained some people with symptoms (but no diagnosis) of BPD. Regression analysis therefore allowed us to explore the independent contributions of BPD pathology and abuse history more specifically. One participant from the BPD group was a multivariate outlier with extreme scores (+ or - 3 SD) on several emotion recognition and identification variables. She was excluded from all analyses where her scores were outside the normal range.

3. Results

3.1 Demographic and clinical characteristics

Demographic and clinical information about participants is provided in Table 1. The groups did not differ in age, F (2,42) = 0.27, P = 0.77, ethnicity, F(2,42) = 0.24, P = 0.79, or marital status, F(2,42) = 0.09, P = 0.91. There were also no differences in verbal intelligence among the groups, F(2,41) = 0.19, P = 0.83.

Of the 15 BPD participants, 5 reported 5 symptoms, 6 people reported 6 symptoms, 3 participants reported 7 symptoms and one participant had 9 symptoms. In the Trauma group, 7 participants reported no symptoms of BPD, 5 participants reported one symptom, one participant had two symptoms, and another participant reported three symptoms. As is evident from Table 1, rates of current mood disorders, anxiety disorders, substance use disorders, and eating disorders were comparable in the BPD and Trauma groups (all Fisher's exact *P* values >.30). The same was true for past Axis I disorders. Current use of medications also did not differ across the BPD and Trauma groups (all Fisher's exact *P* values > .30).

Table 1 also provides information about rates of comorbid Axis II disorders. These were generally comparable across the BPD and Trauma groups. However, OCPD was significantly more common in BPD participants than in participants with a history of trauma, $\chi^2(1) = 7.06$, $P = .01$. Because of this we examined the associations between the presence or absence of OCPD and all the emotion recognition variables of interest. There were no significant findings. The role of this variable was therefore not considered further.

3.2 Childhood Trauma

In general, the BPD group and the Trauma group reported comparable traumatic experiences in childhood. Of the BPD participants, 7/15 (or 47%) reported a history of sexual abuse. This is similar to rate of sexual abuse (6/14 or 43%) in the trauma group (Fisher's exact $P = 1.00$). There was also no significant difference in the rates of physical abuse reported by the BPD participants (8/15 or 53%) and the Trauma group participants (12/14 or 86%; Fisher's exact $P = 0$ .11).

3.3 Task 1: Reaction Time

Oneway ANOVAs revealed no differences in reaction time (time to make a response) between participants in the Control, Trauma, and BPD groups for angry female faces $F(2,41) = 0.96$, $P = 0.39$, angry male faces, $F(2,41) = 0.50$, $P = 0.61$, fearful female faces, $F(2, 41) = 0.90$, $P = 0.42$, fearful male faces, $F(2,41) = 0.59$, $P = 0.56$ or happy female faces, $F(2,41) = 0.80$, $P = 0.46$. However, the groups did differ significantly with regard to their speed of responding to happy male faces, $F(2,41) = 4.88$, $P = 0.13$. A follow up LSD test revealed that participants in the BPD group were significantly slower to respond to happy male faces (Mean = 937.01 ms, SD = 434.58) than were the Control (Mean = 611.96 ms, SD = 198.58; $P = 0.005$) or the Trauma group participants (Mean = 685.83 ms, SD = 185.02, $P = 0.029$). The more BPD traits participants reported the longer it took them to respond to happy male faces, $r(43) = 0.54$, $P < 0.001$.

3.4 Task 1: Emotion Identification

We calculated a "threshold" for each emotion for each sex of target in the photograph. Threshold refers to the point (expressed as a percentage) at which a participant accurately selected the target emotion on at least three out of the four occasions when they viewed a specific stimulus. If a participant never reliably selected the target emotion, a threshold value of 110 percent was assigned. This value was treated as valid because it reflected that the participant needed more "signal" to detect the emotion than was present in the prototypic (100% intensity) expression. A value of 110 percent was assigned on 10 (or 3.7%) of occasions. Most of these (5/10) instances involved participants being unable to reliably detect fear. There was also one instance of a participant being unable to detect female anger, one instance of a participant being

unable to detect female happiness, and one instance where the participant could not reliably identify happiness in male faces. No participants were unable to detect male anger.

3.4.1 Fear

Neither abuse history nor symptoms of BPD predicted recognition thresholds for fear. For fear recognition in male faces, entry of abuse history did not explain significant variance, $F(1,42) = 0.22$, $P = 0.64$, and subsequent entry of BPD symptoms did not improve the model, F change $(1,41) = 0.02$, $P = 0.90$. The same was true for fear expressed in female faces, $F(1, 41) = 0.58$, $P = 0.45$ after entry of abuse history and F Change $(1,40) = 0.67$, $P = 0.42$ after entry of BPD symptoms.

3.4.2 Anger

Contrary to expectation, abuse history was not associated with a lower threshold for recognizing anger. For male faces, entry of abuse history resulted in no significant change in the F value of the model, $F(1,42) = 0.00$, $P = 0.99$. In contrast, and consistent with prediction, BPD pathology was significantly associated with having a lower threshold for recognizing anger in male faces. With abuse history accounted for, subsequent entry of BPD symptoms led to a significant F change $(1,41) = 15.53$, $P < 0.001$, R^2 change = 0.28, adjusted $R^2 = 0.24$, Beta = - 0.54. Detection of anger in female faces, on the other hand, was unrelated to abuse history, $F(1,42) = 1.14$, $P = 0.29$, and to BPD symptoms, F change $(1,41) = 1.84$, $P = 0.18$.

3.4.3 Happiness

Abuse history was associated with a non-significant trend to have problems detecting happiness when it was presented in male faces. Initial entry of abuse history

into the model led to an F change (1,41) of 3.28, $P = 0.078$, $R^{2=}$ 0.07, adjusted $R^2 = 0.05$. The Beta coefficient abuse was 0.27. No significant incremental variance was explained by the entry of BPD symptoms, F change (1,40) = 1.73, $P = 0.20$. When happiness was presented in female faces, abuse history was significantly associated with having an increased recognition threshold, $F(1,,41) = 6.33$, $P = 0.16$, $R^2 = 0.13$, adjusted $R^2 = 0.11$, Beta for abuse = 0.37. As before, however, subsequent entry of BPD symptoms did not explain any additional variance, F change (1,40) = 0.12, $P = 0.73$.

3.4.4 Anger Bias

Finally, we examined errors in anger detection that participants made. More specifically, we counted how many times participants indicated that they saw anger in male or female faces that did not contain anger (i.e, were neutral, happy, or fearful). These were considered misidentified anger responses. The tendency to see anger when it was not present in male faces was unrelated to abuse history, $F(1,,41) = 0.53$, $P = 0.47$. However, it was strongly predicted by BPD pathology, F change (1,40) = 18.55, $P < 0.001$, R^2 change = 0.31, Beta = 0.57. Neither abuse history, F(1,41) = 1.35, $P = .25$ nor BPD, F change (1,40) = 0.92, $P = .34$ predicted seeing anger in female faces when it was not present. For all analyses there was no evidence of multicollinearity. Zero-order correlations between physical and sexual abuse, BPD, and emotion identification thresholds are provided in Table 2.

3.5 Task 2: Emotion Recognition

In Task 2, we examined the level of intensity (e.g., 30% happy) at which participants could recognize an explicitly targeted emotion that they were told to look for. This task thus differed from Task 1 because in Task 1 participants were not told what

emotion would eventually be depicted in the images. Each participant received four exposures to each series of photographs. Thus, each participant identified an emotion in a series four times.

Replicating the findings reported for Task 1, BPD pathology, but not abuse history, was significantly predictive of earlier detection of anger in male faces. Although initial entry of abuse history led to a non significant *F* change, $F(1,42) = 0.23$, $P = 0.64$, entry of BPD symptoms explained a significant amount of the remaining variance, *F* change (1, 41) = 5.55, $P = 0.023$, R^2 change =0.12, Beta = - 0.35. This was not due to people with more BPD traits having faster reaction times to angry male faces, $r(44) = 0.14$, $P = 0.93$. As before, there was no association between BPD and anger detection in female faces. However, having more BPD symptoms was associated with earlier detection of anger in male faces on both Task 1 and Task 2 and participants' performances on these two tasks for anger detection in male faces were highly correlated, $r(44) = .53$, $P < 0.001$). [1] Neither abuse history nor BPD pathology predicted emotion detection thresholds for any of the other emotions (all *P* values > 0.10) and there was no evidence of multicollinearity in the data. Zero order correlations between abuse history, BPD and the emotion recognition variables are provided in Table 3.

4. Discussion

We examined the extent to which borderline personality traits or a history of childhood trauma predicted the level of signal intensity necessary to accurately identify fear, anger, or happiness in pictures of male and female faces. In Task 1, which used short (500 ms) stimulus exposure times, participants with higher levels of borderline pathology required a lower threshold of emotional intensity to detect anger in male (but

not in female) faces. This finding was replicated in Task 2, where participants were able to look at faces for as long as they wished before making their decision. Additionally, participants with more symptoms of BPD were more likely to misidentify anger in male faces that did not contain any anger cues. There was no similar misidentification of anger in female faces. Borderline symptoms and abuse history were unrelated to participants' abilities to detect fear in both male and female faces. However, when stimulus exposure times were short (500 ms) abuse history was associated with difficulties detecting happiness, significantly so in the case of female faces and at the trend level for male faces.

We found no evidence that BPD is associated with being able to correctly classify all emotions at a lower level of intensity. However, as predicted, and consistent with other reports (Daros et al., 2013; Domes et al., 2008; Dyck et al., 2009; Fertuck et al., 2013) we did find that BPD predicted having a negativity bias with regard to emotion recognition. Our results suggest that women with BPD evaluate emotions in male and female faces differently. The gender of the target face is therefore a variable that should be explored more fully in future research.

Regardless of whether they are informed about what emotion to look for (Task 2) or not (Task 1), people with more BPD symptoms appear to be more accurate at identifying anger in male targets. However, this increased accuracy comes at a cost because women with BPD traits are also more likely to misperceive anger in male faces that do not contain anger (i.e, that are neutral or that contain low-intensity happiness or fear cues). Interestingly this response bias for anger in male faces is not explained by childhood

maltreatment. Thus, BPD appears to contribute something unique to emotion recognition, particularly in male faces.

Problematic interpersonal relationships and concerns about abandonment are hallmarks of BPD. Given this we might speculate that people with borderline pathology may be exquisitely attuned to cues that could signal rejection, becoming hypersensitive to detecting anger or displeasure, especially in members of the opposite sex. Consistent with this perspective, using an undergraduate sample, Miano and colleagues (2013) have recently demonstrated that rejection sensitivity mediates the association between features of BPD and facial trust appraisal. Of course, because our sample comprised only female participants, we cannot say whether the emotion recognition differences that we have identified are associated with male faces specifically or faces of the opposite sex more generally. It is certainly reasonable to suggest that women with BPD may have had past relationship experiences that lead them to expect men to be angry even when they are not. However, males with more BPD symptoms might also be inclined to be especially sensitive to anger cues in female faces. In the absence of data from males with BPD, we therefore have no basis for concluding that BPD is associated with problems detecting emotion in male target faces only.

Task 2 was easier for participants because they were informed about which emotion to look for. They were also not required to make a rapid assessment about the emotion contained in the face they were viewing. Performance may also have been further facilitated by the fact that participants were already familiar with the faces that were being used. Regardless, on both tasks, having more BPD symptoms was associated with

earlier detection of anger in male faces. There was also a significant positive correlation between anger detection in male faces across Task 1 and Task 2.

Our findings lend support to therapists' (particularly male therapists') anecdotal impressions that women with BPD are often unduly suspicious and misinterpret therapists' emotional responses (or lack thereof) as angry or hostile. This may be one reason why it is quite common for BPD patients to terminate treatment prematurely (Percudani et al., 2002). Our results also fit well with more empirical findings on this disorder. Compared to healthy controls, people with BPD are significantly less trusting of others (King-Casas et al., 2008) and are quick to feel excluded (Renneberg et al., 2011). Their early memories also contain more malevolent representations of others than the early memories of controls do (Nigg et al., 1992).

Our findings are consistent with research showing amygdala hyper-reactivity in people with BPD during exposure to fearful, sad, happy, and neutral faces (Donegan et al., 2003). As Donegan and colleagues note, hyper-reactivity of the amygdala may incline people with BPD to being hypervigilant and over-reactive to the emotional expressions of others. People with BPD may be intolerant of ambiguity and may have difficulty accepting a neutral face as neutral. Consistent with this, Donegan and colleagues observed that, during the imaging session, several of the BPD participants reported that they were trying to work out what the people with the neutral expressions might be thinking. Some participants even made comments that suggested they were making negative attributions about the people with the neutral faces (e.g., "They look like they are plotting something."). These observations fit well with Meyer et al.'s (2004) findings

that BPD patients often saw negative emotions in neutral expressions and with our findings about the misperception of anger in ambiguous male faces.

We found no evidence of impairment in fear identification and recognition in women with BPD. Similar findings concerning fear appraisal in facial stimuli have also been noted in two recent reports (Daros et al., 2013; Fertuck et al., 2013). Moreover, as was also the case in the Fertuck et al. study, we found that a history of physical or sexual abuse was unrelated to fear perception.

Strengths of our study include having BPD and trauma group participants who were matched for gender, IQ, current and past Axis I diagnoses, and medication usage. Novel aspects of our approach also included consideration of the gender of the emotional face as well as the use of regression analysis to identify aspects of emotion recognition that were associated with BPD after variance in abuse history was accounted for. Despite this, several limitations of the study also warrant mention. The sample was relatively small and comprised only women. Failure of patients with BPD to detect *all* emotions at a lower level of intensity may be due to the small sample size. On the other hand, our results are consistent with a recent meta-analysis showing that emotion recognition abilities in people with BPD are generally intact, except in certain circumstances (Daros et al., 2013). Another limitation was that the trauma group was heterogeneous and included people who reported physical abuse or sexual abuse (or both). We did not attempt to verify trauma exposure using an independent source of information (e.g., court records, sibling reports etc.). The finding that trauma history predicted problems detecting happiness does perhaps validate our approach to some degree. However, contrary to expectation, we did not find that abuse history predicted early recognition of

angry faces, as was reported by Pollack and colleagues (2009). This may be because the participants in our sample were all adults and were no longer experiencing abuse. It could also be because the trauma experienced by our participants was less severe than the abuse experienced by the children in Pollak et al.'s (2009) study, all of whom had come to the attention of Child Protective Services. Given that Fertuck and colleagues (2013) also failed to find an association between abuse history and the appraisal of fear, it is possible that the relationship between these variables is different in adults than it is in children.

Another issue is that our study design used morphed faces that changed in 10 percent increments. This limited the sensitivity of our study. We also only used two faces (one male and one female). It is therefore possible that our findings are specific to the male face we used. However, the fact that participants saw the same faces on numerous occasions may have allowed for some of the enhanced learning noted by Domes et al. (2008) for BPD participants. Our design may thus have revealed some sensitivity differences associated with BPD that might otherwise have gone undetected. Finally, concerns about avoiding Type 2 error led us to conduct a fairly large number of analyses. Nonetheless, even with a stringent Bonferroni correction, our findings linking BPD with earlier identification of anger in male faces and with a tendency to misperceive anger in non-angry male faces remain significant.

BPD is a disorder that is confounded by diagnostic co-morbidity, trauma exposure, and heterogeneity of symptoms. Nonetheless, the results of this study support the unique contribution of borderline personality disorder to emotion processing. Whereas a history of childhood trauma did predict some patterns in emotional judgment, BPD was a more robust predictor of over-identification of anger in male faces. Future research should

explore the role of gender of the target face in emotion recognition. This may help resolve some of the inconsistent findings in the current literature. Future studies should also consider whether a tendency to accurately identify and also to misperceive anger cues in emotional faces is associated with more severe interpersonal difficulties for people with BPD.

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Table 1: Demographic and Clinical Characteristics

Characteristic	Control (n=15) *M*	*(SD)*	BPD (n=15) *M*	*(SD)*	Trauma (n=14) *M*	*(SD)*
Age	26.13	(6.3)	27.80	(7.5)	27.43	(6.2)
Shipley Verbal IQ	34.9	(2.7)	34.4	(3.8)	35.1	(3.3)
Ethnicity (%)						
Caucasian	87.5		86.7		78.6	
African-American	6.3		0		7.1	
Latina	6.3		6.7		0	
Asian/Pacific Islander	0.0		6.7		14.3	
Marital Status (%)						
Single	81.3		86.7		85.7	
Married/Co-habiting	18.8		13.3		14.3	
Past Psychopathology (%)						
Mood Disorder	18.8		73.0		64.3	
Anxiety Disorder	0.0		20.0		28.6	
Substance Use Disorder	6.3		13.3		14.3	
Eating Disorder	0.0		26.6		7.1	
Current Psychopathology (%)						
Mood Disorder	0.0		20.0		14.3	
Anxiety Disorder	0.0		20.0		7.1	
Substance Use Disorder	0.0		33.3		14.3	
Eating Disorder	0.0		6.7		7.1	
Axis II Disorders (%)						
Avoidant	0.0		13.3		6.6	
Dependent	0.0		0.0		0.0	
Obsessive-compulsive	0.0		40.0		0.0	
Schizotypal	0.0		0.0		0.0	
Narcissistic	0.0		0.0		0.0	
Antisocial	0.0		0.0		0.0	
Paranoid	0.0		6.6		0.0	
Current Medications						
Anti-Depressant	0.0		33.3		28.6	
Mood Stabilizer	0.0		26.6		7.1	
Anti-Psychotic	0.0		0.0		0.0	
Benzodiazepine	0.0		13.3		0.0	

Note: There are no significant differences between the BPD and Trauma groups for any of the reported variables with the exception of OCPD, $\chi^2(1) = 7.06$, $P = .01$, which is more common in BPD participants.

Table 2: Correlations between Abuse, BPD and Emotion Identification Threshold in Task 1

	Sexual Abuse		Physical Abuse		BPD	
	r	*P*	*r*	*P*	*r*	*P*
Anger-Male	-0.08	0.62	-0.04	0.78	**-0.54**	**0.001**
Anger-Female	-0.11	0.50	-0.17	0.27	-0.08	0.62
Fear-Male	0.04	0.80	0.13	0.40	0.03	0.85
Fear-Female	-0.23	0.15	0.06	0.70	0.15	0.35
Happy-Male	0.25	0.10	0.20	0.21	0.24	0.12
Happy-Female	0.26	0.15	**0.34**	**0.024**	0.02	0.90
Misperceived Male Anger	0.19	0.22	0.05	0.74	**0.57**	**0.001**
Misperceived Female Anger	0.03	.87	0.22	0.16	0.11	.48

Note: All correlations are two-tailed. Significant correlations are highlighted in bold N= 44 for anger-male and fear-male. N=43 for other analyses. Abuse is measured as present or absent. BPD = number of BPD symptoms assessed using the SCID-II.

Table 3: Correlations between Abuse, BPD and Emotion Recognition Threshold in Task 2

	Sexual Abuse		Physical Abuse		BPD	
	r	*P*	*r*	*P*	*r*	*P*
Anger-Male	0.03	0.87	0.11	0.95	**-0.32**	**0.040**
Anger-Female	-0.02	0.90	-0.24	0.11	-.022	0.16
Fear-Male	0.00	0.98	-0.28	0.066	-0.26	0.097
Fear-Female	0.05	0.74	-0.25	0.10	0.04	0.81
Happy-Male	0.27	0.081	0.09	0.56	0.25	0.11
Happy-Female	0.14	0.38	0.16	0.30	0.14	0.36

Note: All correlations are two-tailed. Significant correlations are highlighted in bold. N= 43. Abuse is measured as present or absent. BPD = number of BPD symptoms assessed using the SCID-II.